

THE U.S. NAVAL OBSERVATORY



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"All the News that Fits, We Print"

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Washington Conference Commemorates 150th Anniversary of the Founding of the U.S. Nautical Almanac Office



Under-Secretary of the Navy the Honorable Jerry Hultin addresses the attendees at the opening reception for the NAO Sesquicentennial

March 3, 1999 marked the 150th anniversary of the establishment of the U.S. Nautical Almanac Office (NAO) by Congress. Since its founding, the NAO and the U.S. Naval Observatory (its modern-day parent organization) have compiled a distinguished record of service to the U.S. Navy, the other armed services, the international scientific community, and

the public by providing reliable, practical astronomical data. These data are used for a wide variety of purposes including navigation, surveying, scientific research, mission planning, and everyday activities.

To commemorate this special event, the U.S. Naval Observatory hosted the Nautical Almanac Office Sesquicentennial Symposium on 3 - 5 March 1999 in Washington, DC. The symposium covered a broad spectrum of topics including the history of the office, its mission, the users of its products, the underlying science, and a look toward the future. The attendees, all invited, came from diverse backgrounds, both military and civilian, and were international in scope. In addition to papers presented by the Nautical Almanac Office staff, invited speakers included scientists and historians from a variety of institutions. Program information for the Symposium may be found on the Astronomical Applications Department web site at URL:

<http://aa.usno.navy.mil/NAO150/>

In 1849, Congress established the Nautical Almanac Office to prepare and publish an official national almanac. Up to that time American scientists and seamen relied on foreign almanacs - particularly those of Great Britain - for astronomical and navigational data. Privately published almanacs, such as Benjamin Franklin's *Poor Richard's Almanac*, were generally not adequate for scientific use.

The Office was placed under the direction of Lieutenant Charles Henry Davis, an experienced naval officer with a scientific background and personal

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associations with prominent American scientists. Davis established the Office in Cambridge, Massachusetts, independent of the U.S. Naval Observatory in Washington. In Cambridge the Office had access to Harvard University and Professor Benjamin Peirce, the leading American mathematician of the time. The Office would remain in Cambridge until 1866, when it was moved to Washington, DC. In 1893, the Nautical Almanac Office moved into office space at the U.S. Naval Observatory's new home north of Georgetown.

In 1852, the Office published its first volume, *The American Ephemeris and Nautical Almanac* for 1855. An extract of this, *The American Nautical Almanac* for 1855, was issued for mariners. *The American Ephemeris and Nautical Almanac* provided data needed by astronomers and surveyors. In addition to its practical purpose, it served as a source of national pride. The volume was regarded as an important demonstration of the developing scientific prowess in the United States. *The American Ephemeris and Nautical Almanac* and its successors, *The Astronomical Almanac* and *The Nautical Almanac*, have been published continuously ever since. *The Air Almanac*, a publication geared towards aviation navigation, has been published continuously since 1941.

Over the years, the Nautical Almanac Office has employed several of the nation's most able astronomers and mathematicians, including Simon Newcomb and G. W. Hill, whose 19th Century theories on the motions of the planets remained in use until the 1980's. In the 1940's, the first mechanical computers dramatically improved the accuracy and streamlined the production of the Almanacs. In the 1960's, the Office established a close and lasting relationship with Her Majesty's Nautical Almanac Office in Great Britain and with scientists at the Jet Propulsion Laboratory. *The Astronomical Almanac* (a new, joint publication of the British and American Offices) was introduced in 1984.

Today, the Nautical Almanac Office is a part of the USNO's Astronomical Applications Department. It continues to provide annual printed almanacs for air and marine navigation, and for use by astronomers worldwide. In addition, it continues to develop and refine computer-based almanacs, such as the **Multiyear Interactive Computer Almanac (MICA)**,

and to provide a wide range of free, interactive almanac data via the USNO's World Wide Web site. In addition to providing critical astronomical data, the Astronomical Applications Department also carries out a modest research program in diverse areas, including celestial mechanics, positional astronomy, and navigation to enable it to meet future needs.

U.S. Naval Observatory Satellite Selected by NASA for Feasibility Study



The National Aeronautics and Space Administration (NASA) has selected the USNO's **Full-sky Astrometric Mapping Explorer (FAME)** to be one of five proposed satellites funded for a feasibility study. FAME is a satellite designed to determine the positions, distances, and motions of stars within our galactic neighborhood. It will observe and determine the positions of stars brighter than 15th magnitude, which is about 40 million stars. FAME will determine the distances of stars with less than 10% error for stars brighter than 9th magnitude and within 2000 parsecs of the Sun.

FAME will map our region of the galaxy with unprecedented accuracy," said Dr. P. Kenneth Seidelmann, the Director of Astrometry at the Naval Observatory and the Chairman of the FAME science team.

Astrometry, the science of determining positions of stars, is the oldest branch of astronomy. Astrometric measurements not only determine the positions of stars on the sky, but also the distances to stars can be determined by measuring their parallaxes. The parallax is the apparent change in a star's position due to the Earth's revolution around the Sun over the course of a year.

FAME will be able to detect giant planets with masses of two times the mass of Jupiter and larger orbiting neighboring stars. By measuring the positions of stars over time, FAME will be able to detect the "wobbling" of stars due to companion objects such as other stars, brown dwarfs, and giant planets. By determining the distances to variable stars called Cepheids, FAME will improve our measurements of distances to galaxies and our understanding of the size of the Universe. Cepheids are used to measure distances of galaxies, and are the basis of a system astronomers use to determine the distances to objects in the Universe. It will also create a large, rich database of information on stellar properties including the brightness and colors of stars.

"This database will enable studies of stellar structure and the evolution of stars, providing a better understanding of the structure of stars and how the Sun has aged and will age over time," says Dr. Scott Horner of the U.S. Naval Observatory. By studying the motions of stars in the Milky Way, FAME will also measure the amount of dark matter in the galactic disk, providing clues to the formation of galaxies and the evolution of the Universe.

FAME was one of five satellites selected for feasibility studies as part of NASA's medium-class Explorer (MIDEX) program. The five selected missions were judged to have the best scientific value among the 35 proposals submitted. NASA will select two of the five missions for construction and launch in September, 1999. If selected, FAME will be launched in 2003.

Led by Dr. Kenneth J. Johnston, Scientific Director of the U.S. Naval Observatory in Washington D.C., the FAME project is a collaborative effort of the U.S. Naval Observatory, the Naval Research Laboratory (Washington, D.C.), Lockheed Martin Missiles and Space (Palo Alto, CA), Smithsonian Astrophysical Observatory (Cambridge, MA), the Infrared Processing and Analysis Center (Pasadena, CA), and Omitron, Inc. (Greenbelt, MD). The FAME project has a total mission cost of \$138 million.

More information on FAME can be found at the FAME web site: <http://www.usno.navy.mil/fame>.

USNO Celebrates "Astronomy Day" with Open House

Geoff Chester, Public Affairs

On May 26th, 1999, USNO held its first "Astronomy Day" Open House in nearly a decade. Nearly one hundred Staff and "off-base" volunteers helped show off the Observatory to about 1100 visitors, and the weather cooperated beautifully.

In addition to solar viewing through the 12-inch and various amateur telescopes provided by the Northern Virginia Astronomy Club (NOVAC) and the National Capital Astronomers, visitors had a chance to see Venus through the 24-inch. Brian Mason entertained visitors with floor rides and a presentation of the Speckle Interferometry program in the 26-inch telescope dome.

Each Department prepared exhibits on their particular activities. Rich Schmidt and several Time Service cohorts mounted a new exhibit on GPS time and exhibited their Western Union clock, recently found on the eBay web site.

AA, EO, and FM had exhibits set up in the lobby of B52. MWR did a brisk business, with stands at the flagpole and the picnic area.

Visitor response was very enthusiastic. Many people remembered the open houses of years past, and were glad to see us back "in business" with them again.

It was a good primer for the Open House now scheduled for New Years Eve. Hopefully it will re-establish a tradition for the years to come.

Asaph Hall Memorabilia Now On Display in Library

Geoff Chester, Public Affairs

The USNO Library now has yet another group of treasures to proudly display. After a year of planning and design, a display case housing the three medals presented by the descendants of Asaph Hall has been installed at the end of one of the wrought iron book shelves. The case, with a mirror on its rear wall,

allows the observer to inspect both sides of the Arago Medal from the French Academy of Sciences, the Chevalier of the French Legion of Honor, and the Gold Medal of the Royal Astronomical Society. It also houses the original observing logbook for the "Great Equatorial" telescope, with Hall's observations confirming the discovery of Phobos and Deimos.

Hanging directly above the case is a reproduction of Asaph Hall's commission into the U.S. Navy Corps of mathematicians, signed by Abraham Lincoln. The original rests in the Library archives. The case and the Commission have been installed under the gaze of Asaph Hall's modern portrait.



The new Asaph Hall Medal display case in the Library. Photo by Annette Hammond

Security News

USNO POLICE EMERGENCY NUMBERS

34th Street Gate (24 Hours): 762-1468

Shift Lieutenant: 762-0336

Shift Sergeant: 762-0338

Local Emergency Number: Dial 99 + 911.

When calling the local emergency number please notify the USNO police in order to escort the emergency personnel and vehicles to the scene.

GATES (Hours of Operation):

34th Street Gate: Open 24 Hours/7 Days Per Week

South Gate: Open Monday through Friday, 0545 - 1830

Wisconsin Gate: Closed until further notice

Davis Street Gate: Closed

Gilliss Avenue Gate: Opened as Directed, otherwise closed

Wisconsin Turnstile: 24 Hours Daily (Must have USNO Swipe Card to re-enter)

USNO In The News

Geoff Chester, Public Affairs

The Leonid meteor shower was very good to the USNO this year. During the week surrounding the shower's peak in mid-November, 1998, the Observatory was featured prominently in the print and broadcast media. The PAO answered numerous queries from local television and radio stations. The national media took an interest as well, culminating in an appearance on the NBC "Today" show.

The introduction of the Leap Second on New Years Eve was also a popular media magnet. Dr. McCarthy and Dr. Matsakis did an excellent job fending off reporters for this event.

The Millennium continues to be a popular source of reporter queries. The PAO typically responds to several phone calls and/or e-mails on the subject daily. This will only pick up as the "magic" moment draws nigh!

ABSTRACTS OF RECENT PAPERS:

BINARY STAR ORBITS FROM SPECKLE INTERFEROMETRY. I. IMPROVED ORBITAL ELEMENTS OF 22 VISUAL SYSTEMS

Brian D. Mason, Geoffrey G. Douglass, and William I. Hartkopf

For publication in the February 1999 *Astronomical Journal*

ABSTRACT:

Improved orbital elements for twenty-two binary systems are presented. For twelve systems, masses are calculated using available trigonometric parallaxes and making certain assumptions regarding the mass ratio. For the other ten systems, provisional elements are provided which should provide relatively accurate ephemerides for the next decade.

ADAPTIVE OPTICS OBSERVATIONS OF ARCTURUS USING THE MOUNT WILSON 100-INCH TELESCOPE

Nils H. Turner, Theo A. ten Brummelaar, and Brian D. Mason

For publication in the May 1999 *Proceedings of the Astronomical Society of the Pacific*

ABSTRACT:

Upon inspection of the multiple star results in the HIPPARCOS catalog, the flag for entry number 69673 particularly stands out; it is Arcturus, for which no companion has been reported previously. The HIPPARCOS companion is reported to be at a separation of 0.255 ± 0.039 arcsec with a magnitude difference in a broadband filter (peaked near 460 nm) of 3.33 ± 0.31 . We present recent results using the natural guide star adaptive optics system on the Mount Wilson 100-inch telescope showing Arcturus to be a single star.

HIGH-REDSHIFT QUASARS FOUND IN SLOAN DIGITAL SKY SURVEY COMMISSIONING DATA

Xiaohui Fan, Michael A. Strauss, Donald P. Schneider, James E. Gunn, Robert H. Lupton, Brian Yanny, Scott F. Anderson, John E. Anderson, Jr., James Annis, Neta A. Bahcall, J. A. Bakken, Steven Bastian, Eileen Berman, William N. Boroski, Charlie Briegel, John W. Briggs, J. Brinkmann, Michael A. Carr, Patrick L. Colestock, A. J. Connolly, J. H. Crocker, Istvan Csabai, Paul C. Czarapata, John Eric Davis, Mamoru Doi, Brian R. Elms, Michael L. Evans, Glenn R. Federwitz, Joshua A. Frieman, Masataka Fukugita, Vijay K. Gurbani, Frederick H. Harris, Timothy M. Heckman, G. S. Hennessy, Robert B. Hindsley, Donald J. Holmgren, Charles Hull, Shin-Ichi Ichikawa, Takashi Ichikawa, Zeljko Ivezic, Stephen Kent, G. R. Knapp, Richard G. Kron, D.Q. Lamb, R. French Leger, Siriluk Limmongkol, Carl Lindenmeyer, Daniel C. Long, Jon Loveday, Bryan MacKinnon, Edward J. Mannery, P. M. Mantsch, Bruce Margon, Timothy A. McKay, Jeffrey A. Munn, Thomas Nash, Heidi Jo Newberg, R. C. Nichol, Tom Nicinski, Sadanori Okamura, Jeremiah P. Ostriker, Russell Owen, A. George Pauls, John Peoples, Donald Petravick, Jeffrey R. Pier, Ruth Pordes, Angela Prosapio, Ron Rechenmacher, Gordon T. Richards, Michael W. Richmond, Claudio H. Rivetta, Constance M. Rockosi, Dale Sandford, Gary Sergey, Maki Sekiguchi, Kazuhiro Shimasaku, Walter A. Siegmund, J. Allyn Smith, Chris Stoughton, Alexander S. Szalay, Gyula P. Szokoly, Douglas L. Tucker, Michael S. Vogeley, Patrick Waddell, Shu-i Wang, David H. Weinberg, Naoki Yasuda, and Donald G. York

For publication in the July, 1999, issue of *The Astronomical Journal*.

ABSTRACT

We present photometric and spectroscopic observations of 15 high-redshift quasars ($z > 3.6$) discovered from ~ 140 deg² of five-color (u'g'r'i'z') imaging data taken by the Sloan Digital Sky Survey (SDSS) during its commissioning phase. The quasars are selected by their distinctive colors in SDSS multicolor space. Four of the quasars have redshifts higher than 4.6 ($z=4.63$, 4.75, 4.90 and 5.00, the latter being the highest redshift quasar yet known). In addition, two previously known $z > 4$ objects were

recovered from the data. The quasars all have $i^* < 20$ and have luminosities comparable to that of 3C273. The spectra of the quasars have similar features (strong, broad emission lines and substantial absorption blueward of the Ly alpha emission line) seen in previously known high-redshift quasars. Although the photometric accuracy and image quality fail to meet the final survey requirements, our success rate for identifying high-redshift quasars (17 quasars from 27 candidates) is much higher than that of previous multicolor surveys. However, the numbers of high-redshift quasars found is in close accord with the number density inferred from previous surveys.

CLOSE PAIRINGS OF GALILEAN SATELLITES OBSERVED USING SPECKLE INTERFEROMETRY

B. D. Mason, G. H. Kaplan, G. G. Douglass, D. Pascu,
U.S. Naval Observatory

K. Aksnes
Institute for Theoretical Astrophysics, Oslo

Poster paper for presentation at the AAS Division on
Dynamical Astronomy (April 1999)

ABSTRACT:

During November-December 1998, a series of events occurred involving the Galilean satellites of Jupiter, where two satellites (usually Io and Europa, but sometimes Europa and Ganymede) passed within 5 arcsec of each other. Depending on the orbital geometry and closest separation (as close as 2.9 arcsec) the events lasted anywhere from 20 minutes to several hours.

Since 5 arcsec roughly defines the atmospheric isoplanatic patch, attempts were made to observe these events using the speckle interferometry camera attached to the U.S. Naval Observatory (USNO) 26-inch refractor. The camera and associated software are normally used for precise measurements of the distance and position angle of binary star components. For the satellite events, the goal was to obtain very precise relative positions of the satellite pairs at specific times, as well as the time of apparent closest separation. Speckle observations of binary stars made from USNO typically yield positional accuracy of about 1% of the component separation.

We successfully observed 4 out of a possible 8 events visible from USNO. Reduction of these observations is in progress. Despite the fact that the Galileans are resolved, not point sources, autocorrelations of the speckle patterns appear fairly strong. However, because of the relative motion of the satellites, only short integration times can be used, and it remains to be seen whether the signal-to-noise ratio will permit relative position measurements of useful precision.

Close pairings of the Galilean satellites occur in series that are determined by the mutual resonances, within a geometric envelope defined by the apparent inclination of the orbital planes (i.e., Jupiter's equator) and distance. There is another series of events in May-June 1999, then again in January 2000. This technique may also be applicable to some of the Saturnian satellites near the time of ring-plane crossing. We invite other speckle interferometry groups to attempt observations of these events so that the usefulness of the technique can be better determined.

THE USNO SIM GRID STAR SELECTION PROGRAM

B.D. Mason, T.E. Corbin, A.R. Hajian, C.A. Hummel,
T.J. Rafferty, N. Zacharias

Oral Talk at the Division of Dynamical Astronomy
Meeting, Estes Park, CO, April-May, 1999.

ABSTRACT:

The United States Naval Observatory (USNO) is in the process of preparing an input catalog of SIM grid stars by utilizing existing databases, observing capabilities, and instrumental development. The SIM grid should be astrometrically stable at the 4 microarcsecond level over the five year life of the program, therefore, double and multiple stars must be avoided. Stars in the apparent magnitude range $6.5 < m < 8.5$ with spectral types from A5V through G5V are being considered. Known doubles have been eliminated, and proper motions will identify previously unknown, wide pairs. This program involves a comprehensive selection and observing program, the first half year of which has seen candidate selection and the start of survey observations with the USNO speckle camera. In later years, further elimination of doubles will be made astrometrically with the Navy Prototype Optical

Interferometer and wide-field CCD work. In addition, a Fourier Transform Spectrometer (FTS), with a potential for sub-meter per second radial velocity determinations, is being developed to eliminate companions (both stellar and substellar). In total, 7,200 candidate stars, evenly distributed over the sky will be examined observationally. The combination of the four astrometric methods will remove double and multiple systems in the ~ 15 arcsec to ~ 1 milli-arcsecond range with Delta-m of 3.5 magnitudes, while the FTS is expected to detect companions with masses as low as Saturn in the range of 0.1 to 10 au. The first year of the program has thus far seen significant progress. The SIM grid candidate list has been prepared and speckle observations of these candidates have begun: in the northern hemisphere, by the USNO and the RIT/Yale group (Elliott Horch & Zoran Nikov, Rochester Institute of Technology and William van Altena, Yale).

SPECKLE INTERFEROMETRY OF NEW AND PROBLEM HIPPARCOS BINARIES

Brian D. Mason, Christian Martin, William I. Hartkopf, Donald J. Barry, Marvin E. Germain, Geoffrey G. Douglass, Charles E. Worley, Gary L. Wycoff, Theo ten Brummelaar, and Otto G. Franz

For publication in the April 1999 *Astronomical Journal*

ABSTRACT:

The ESA Hipparcos satellite made measurements of over 12,000 double stars and discovered 3,406 new systems. In addition to these, 4,706 entries in the Hipparcos Catalogue (ESA 1997a) correspond to double star solutions which did not provide the classical parameters of separation and position angle, but were the so-called "problem stars", flagged "G", "O", "V" or "X" (field H59 of the main catalogue). An additional subset of 6,981 entries were treated as single objects but classified by Hipparcos as suspected non-single" (flag "S" in field H61), thus yielding a total of 11,687 "problem stars". Of the many ground-based techniques for the study of double stars, probably the one with the greatest potential for exploration of these new and problem Hipparcos binaries is speckle interferometry. Results are presented from an inspection of 848 new and problem Hipparcos binaries, using both archival and

new speckle observations obtained with the USNO and CHARA speckle cameras.

THE FUTURE OF ALMANAC DATA IN THE UNITED STATES

John A. Bangert

To be published in the *Proceedings of the Nautical Almanac Office Sesquicentennial Symposium*.

ABSTRACT:

Numerous factors - such as changes in technology, navigation policy, user requirements, and funding levels - make it difficult to predict the future of almanac data in the U.S. In the last few years, there have been detailed discussions of the future of almanacs, both within the U.S. Naval Observatory (USNO), and between USNO and the staff of H.M. Nautical Almanac Office (HMNAO) of the UK. Some definite decisions emerged from these discussions. In some cases, the decisions are already being put into practice.

In other cases, the decisions are forming the basis of long-term plans for changes in the products produced by the two almanac offices. This paper will draw on the discussions mentioned above and present current plans for the future of almanac data produced or co-produced by USNO's Astronomical Applications (AA) Department. This paper will use a broad definition of "almanac data," to include not only printed almanacs, but also software almanacs and almanacs designed for use on the Internet.

NEW TECHNOLOGY FOR CELESTIAL NAVIGATION

George H. Kaplan

To be published in the *Proceedings of the Nautical Almanac Office Sesquicentennial Symposium*.

For all U.S. defense forces, GPS is now the primary means of navigation. Navy navigation policy also calls for at least one alternate means of navigation, which must be independent of the primary. In recent years, however, alternative electronic navigation systems such as Omega and TRANSIT have been

shut down. Celestial observations still have a role to play in surface and air navigation. This paper reviews recent developments in both hardware and software that overcome many of celestial navigation's traditional limitations. Compact, self-contained star trackers could be combined with inertial navigation systems to produce a reliable, accurate, all-weather alternative to GPS.

A VIEW FROM THE DECKPLATES

QMC (SW) Patrick G. McCarthy, USN

To be published in the *Proceedings of the Nautical Almanac Office Sesquicentennial Symposium*.

ABSTRACT:

The current practice of celestial navigation on board a Navy surface vessel is reviewed. The author also gives his views concerning the role of celestial navigation in the modern Navy: no matter how advanced electronic navigation becomes, there will be a time when traditional, celestial techniques will be useful.

THE ASTRONOMICAL APPLICATIONS DEPARTMENT TODAY

John A. Bangert

To be published in the *Proceedings of the Nautical Almanac Office Sesquicentennial Symposium*.

ABSTRACT:

The Astronomical Applications (AA) Department of the U.S. Naval Observatory is now the parent organization of the U.S. Nautical Almanac Office established in 1849. The scope of activities involving almanacs has expanded dramatically over 150 years, in ways in which our early predecessors could never have imagined. This paper will provide an overview of the department, with the primary focus on its current mission. Today, the AA Department provides practical astronomical data via a broad spectrum of products and services, and has an active research component aimed at supporting and improving these products.

CESIUM FOUNTAIN DEVELOPMENT AT USNO

Eric A. Burt

Presented at the Joint Meeting of the 13th European Frequency and Time Forum and the 1999 IEEE International Frequency Control Symposium, Besancon, France, April 13-16, 1999.

ABSTRACT:

In this paper we discuss progress made at the U.S. Naval Observatory towards building a cesium fountain atomic clock. In particular we will address the efficacy of a 4-beam optical lattice as an atom collection and launch mechanism. To date we have measured temperatures in a 4-beam lattice of 1.4 (0.3) °K and have launched atoms from this lattice to a height of just under a meter with a temperature of 1.7(0.1) °K. We are able to collect 2.4×10^6 atoms using only the lattice beams and no magnetic fields. We have completed the design for and are in the process of fabricating all aspects of the fountain device, including the collection region, the drift region, the microwave cavity and the magnetic shields. We will present our progress to date, including a discussion of our launch results and the design and testing of our magnetic shields.

ACCURATE OPTICAL POSITIONS OF EXTRAGALACTIC RADIO REFERENCE FRAME SOURCES ¹

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Submitted to *The Astronomical Journal*.

ABSTRACT:

Optical positions on the 50 mas level in the Hipparcos system have been obtained for 327 extragalactic radio reference frame sources for both

hemispheres from a 2-step procedure. Positions of secondary reference stars in the $10 = V = 14$ magnitude range were obtained from photographic plates taken at the Hamburg astrograph (Northern Hemisphere) and the USNO astrograph at Black Birch (Southern Hemisphere) using Hipparcos stars for astrometric plate solutions. Positions of the optical counterparts of compact, extragalactic, radio reference frame sources were then obtained from CCD direct imaging at the KPNO and CTIO 0.9-meter telescopes, using the secondary reference star positions and correcting for field distortions. Several previously unknown counterparts could be identified and several previously suspected identifications turned out to be empty fields. CCD images are posted on the Web to serve as finding charts. A comparison between the optical and radio positions reveals systematic offsets of 10 to 40 mas per coordinate as a function of the observing run. Corrections for galactic rotation and solar motion have been attempted due to a lack of individual proper motions for the secondary reference stars. Neither 0.9m telescope is an astrometric instrument and limitations are clearly seen in remaining systematic errors. Orientation angles between the radio system and our optical data are zero within an accuracy of 4 mas (standard error). A significant reduction of the systematic errors will be achieved with new wide-field CCD imaging currently been taken in parallel to new 0.9m observations, to provide more secondary reference star positions with higher precision at a common epoch which will allow extended modeling of the mapping properties of 0.9m observations.

¹ Based in part on observations obtained at CTIO and KPNO, divisions of the National Optical Astronomy Observatories, which is operated by the Association of Universities for Research in Astronomy, Inc. under cooperative agreement with the National Science Foundation.

² with Universities Space Research Association, Washington DC

TAC ON THE HIPPARCOS SYSTEM

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U.S. Naval Observatory, Washington, DC 20392

Submitted to *The Astronomical Journal*.

ABSTRACT:

The Twin Astrographic Catalog (TAC) is an astrometric, photographic catalog covering most of the sky between declinations $+90^\circ$ and -18° to a limiting magnitude of about $V=12$ and $B=12.5$. This release 2 is based on the same 4912 plates as release 1, which were taken with the U.S. Naval Observatory Twin Astrograph (Blue and yellow lens) between 1977 and 1986. The Hipparcos Catalogue has been used for a new plate-by-plate rigorous reduction. A significant improvement over the release 1 version of the data was achieved. With an average precision of 48 to 120 milliarcsecond (mas) per coordinate, depending on magnitude, and a higher star density than the Tycho Catalogue, the TAC is a significant catalog for proper motion determination. This release 2 of the TAC contains high quality positions of 705099 stars, supplemented by photographic photometry (B and V) for most of these stars. Astrometric reduction and catalog construction details are discussed and the final product is described, which is available from the U.S. Naval Observatory.

¹ with Universities Space Research Association, Washington DC

CPC2 ON THE HIPPARCOS SYSTEM

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Germany

Submitted to *The Astronomical Journal*.

ABSTRACT:

The Second Cape Photographic Catalog (CPC2) is an astrometric, photographic catalog covering the entire Southern Hemisphere to a limiting magnitude of about 10.5. The Hipparcos Catalogue has been used for a new plate-by-plate rigorous reduction. A significant improvement over the release 1 version of the data was achieved. With an average accuracy of 53 milliarcsecond (mas) and a mean epoch of 1968, the CPC2 is a key catalog for proper motion deter-

mination. This release 2 of the CPC2 contains high quality positions of 266629 stars and an appendix of 8040 other stars. Catalog reduction and construction details are given as well as a description of the final product, which is available on CD-ROM from the U.S. Naval Observatory.

¹ with Universities Space Research Association, Washington DC

Fun at the USNO Christmas Party

120 people attended the party held at the Holiday Inn, Georgetown from 11:30 to 3:00 on Dec 17, 1998. John Bangert (AA Department) was master of Ceremonies for the festive event, which culminated in the annual appearance of Santa Claus, whose sense of humor was oddly reminiscent of a certain Requirements Officer...

Door prizes included a Holiday Inn stay for 2, Electronic Equipment, Gift Certificates, Movie Tickets, mugs for everyone, popcorn, sweatshirts, and Christmas ornaments donated by the Recreation Committee.

Arrangements were made by AA, RM, and IT.



SD asks Santa for FAME funding at USNO Christmas Party

From The Editor

With this issue of the *STAR* we begin a new experiment: the virtual newsletter. One of the major headaches of preparing the *STAR* is production; somebody has to stand by the copier and crank out 180 or so copies each time a new issue is published.

Well, we're going to change that, hopefully for the better. Beginning with this issue we'll be publishing to the Web. You'll need to get a copy of the free Adobe Acrobat Reader, but once that's installed you should see a nice screen that looks better than the print edition.

A distinct advantage is that every issue will now have color, and if you desire a hard copy you can send it to your favorite printer and get the same quality as the copy master I use to run off the Xeroxes.

As always, I welcome comments and articles from interested readers. Yes, the *Companion STAR* is still in the works, and now that e-publishing has made its way to the Public Affairs Office we may even see it in a few more weeks.



Watch This Space! In a month or two we will see the USNO Millennium Time Ball here...

The U.S. Naval Observatory *Star*

U.S. Naval Observatory, Washington, D.C.

Superintendent

Captain Dennis Larsen

Deputy Superintendent

Commander Mark Gunzelman

Scientific Director

Dr. Ken Johnston

Editor

Geoff Chester

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